understood all of the words and ideas included in the questions. To the maximum extent possible, questions have been constructed to allow respondents to indicate that they did not fully comprehend some items, and interviewers were instructed to denote those interviews where respondents appeared to have a problem with comprehension, but it is likely that some respondents who did not fully comprehend some items still offered a response.

Additionally, some respondents may not have taken the interview seriously, or may have offered insincere responses. The NORC interviewers were trained to identify respondents who seemed to be intoxicated or unable to engage in a conversation and to reschedule those interviews for another time at which the respondent might be. more sober or serious. The interviewers also flagged any cases in which the seriousness of the respondent was in doubt. Nevertheless, it is likely that a few respondents offered less than serious responses to some of the items.

A final source of potential error is in the coding of the open-ended items. A number of the questions in the 1999 study involved the collection of open-ended responses from the respondents and the subsequent coding of those responses into numeric codes. All of the coding was closely supervised, as has been described in previous sections, and the inter-coder agreements were high. Additionally, NORC interviewers received extensive training in the capture of the open-ended responses. Nonetheless, it is likely that some of the information included in some of the original responses were not completely entered into the record, or were not coded accurately.

Despite these possible sources of error, the 1999 study reflects the careful use of standard survey research methods and the resulting data provide reasonable estimates of the major attitudinal, behavioral, and knowledge dimensions included in the study.

RECOMMENDATIONS

On the basis of the experience in 1999 and in previous years, we recommend retaining the basic structure of the study. Looking at the time-series record built over the last two decades, a sound time-series has been constructed that is now widely used for a wide rage of public policy purposes. Despite increasing response rate problems in most national surveys, we believe that a national study of adult understanding and attitudes still provides essential time-series measures that are relevant to the formulation of public policy. There are, however, some minor changes and improvements that we believe would enhance the value of the study in the future.

Sampling

We are concerned that there is a growing use of cellular telephones and similar instruments as replacements for household telephones, and we recommend that the sample design address this potential source of error. There are conflicting reports in the literature concerning the magnitude of this problem, but it is important that future sample designs explicitly address this problem.

Instrument and Mode

We recommend the continued use of a telephone interview format, with prior letters of introduction to all households for whom a name and address can be acquired. The experience of recent years demonstrates that most respondents find the interview interesting and that few respondents break off the interview prior to completion of the interview.

Over recent decades, the use of open-ended responses in the Science and Engineering Indicators study has been a major component of the quality of this study. To improve the accuracy of the capture and coding of open-ended responses, however, we recommend the introduction of digital-voice-capture technology into *the Science and Engineering Indicators* study. This approach was used by Professors Miller and Kimmel in their 1997 study of public attitudes toward biotechnology and proved to be valuable in the coding and analysis of open-ended knowledge and attitude measures. When asked if they would agree to the digital capture of their open-ended answers, over 95 percent of the 1997 respondents agreed to the recording.

Data Collection Protocols

The declining response rate is a major threat to the validity of the *Science and Engineering Indicators* study. In 1999, a set of strategies were proposed to increase response rate, and the resulting 66 percent rate was attained through substantial effort. In retrospect, it is clear that a program of offering incentives for participation needs to be designed and implemented from the beginning of the study. In 1999 and in previous years, cash incentives have been offered only after it was clear that the response rate was too *low*. In future *Science and Engineering Indicators* studies, we recommend that a clear policy on incentives be adopted prior to the initiation of field work and that respondents who refuse to participate twice be offered an incentive immediately by the interviewer. In 1999 and prior years, it was not uncommon for a respondent to be asked to participate numerous times prior to offering any incentive, and when an incentive was offered, it was usually offered two or three months after the initial date of contact. We believe that a conscious up-front policy of incentives will increase the response rate and reduce the costs of numerous follow-up calls that fail to produce a completed interview.

Post Survey Processing

Parallel to the use of digital technology to record open-ended responses, it is essential to develop a system for multiple coders to code each item without knowledge of the coding decisions of other coders and for the reconciliation of coding disagreements. The procedures developed by Professors Miller and Kimmel in their 1997 biotechnology study should be studied for possible use in the coding of digitally-recorded open-ended responses, if that technology is introduced into the *Science and Engineering Indicators* study.